

What is claimed is:

1. System for cleaning tubes of tube-bundle type heat exchangers including a plurality of tubes (5) arranged in parallel between two chambers (10a, 10b) and in which a fluid medium, in particular crude oil, circulates at a temperature above 120°C, wherein, for cleaning said tubes (5), deposits at the inner wall of said tubes (5), such as coking, dirt particles or the like, are released by cleaning bodies passing through said tubes (5) and carried out of said tubes (5),

characterized in that

- said cleaning bodies (1a-1h) are formed such that they are
- resistant to temperatures (above 120°C) and
- able to withstand aggressive fluid media such as crude oil and
- freely transported in the flowing fluid medium, in particular with large flow-through diameters, such as in said chambers (10a, 10b) of said heat exchanger (10), and sink or rise in the stagnant fluid medium; and
- have an outer contact surface suitable for removing deposits from a tube inner wall,
- pass through said tubes (5) due to the pressure of the fluid medium, and
- have their contact surfaces forced against the tube inner wall due to contact pressure.

2. System according to claim 1, characterized in that, after passing through said tubes (5), said cleaning bodies (1a-1h) are collected and introduced into the inlet openings of said tubes (5) for a further cleaning pass through said tubes (5) as necessary.

3. System according to claim 1 or claim 2, characterized in that said cleaning bodies (1a-1h) are recycled, namely after the continuous or discontinuous pass through said tubes (5), by being either directly reintroduced at the inlet side of the tubes (5) for another pass or by being first collected in a catching device, and the cleaning of the tubes (5) is interrupted and carried out again after a predetermined period of time has elapsed or depending on the amount of dirt or another parameter.

4. System according to claim 2 or claim 3, characterized in that in the recycling conduit for said cleaning bodies (1a-1h) between the inlet and outlet sides of the heat exchanger, a filter or a moveable or fixed sieve for retrieving said cleaning bodies (1a-1h) from the media flow is provided as a catching device for said cleaning bodies (1a-1h).
5. System according to any of claims 2 to 4, characterized in that downstream of the catching device there is a lock for filling, retrieving and intermediate storage of the cleaning bodies (1a-1h) during the interruption of the tube cleaning.
6. Cleaning bodies for systems that clean tubes of heat exchangers, in particular tube-bundle type heat exchangers, including a plurality of tubes arranged in parallel between two chambers and in which a fluid medium, in particular crude oil, circulates at a temperature above 120°C, characterized in that the cleaning bodies (1a-1h) are formed in such a way that, for cleaning said tubes (5) of the heat exchanger, deposits at the inner wall thereof, such as coking, dirt particles or the like, are detached by cleansing and carried out of said tubes (5) when said cleaning bodies (1a – 1h) pass through said tubes (5).
7. Cleaning bodies according to claim 6, characterized in that the cleaning bodies (1a-1h) are formed in such a way that they are
 - resistant to temperatures (above 120°C) and
 - resistant to aggressive fluid media such as crude oil, and
 - are freely transported in the flowing fluid medium, in particular with large flow-through diameters, such as in said chambers (10a, 10b) of said tube-bundle type heat exchanger, and sink or rise in the stagnant fluid medium; and
 - comprise an outer contact surface suitable for cleansing deposits from an inner wall of a tube,
 - pass through said tubes (5) due to the pressure of said fluid medium and
 - have their contact surfaces forced against the tube inner wall due to contact pressure.

8. Cleaning bodies according to claim 6 or claim 7, characterized in that said cleaning bodies (1a-1e') are formed to be essentially spherical resilient rolling bodies having a cleaning surface, wherein the entire surface of said cleaning bodies (1a-1e') forms the contact surface for removing deposits from the tube inner wall.
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9. Cleaning bodies according to any one of claims 6 to 8, characterized in that the outer diameter of said cleaning bodies (1a-1e') in their uncompressed state, i.e. before introduction of the cleaning bodies (1a-1e') into said tubes (5), is greater than the inner diameter of said tubes (5) and adapts to said inner diameter when said cleaning bodies (1a-1e') are introduced into the inlet openings of said tubes (5) and are resiliently compressed therein.
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10. Cleaning bodies according to any one of claims 6 to 9, characterized in that said cleaning bodies (1a-1e') comprise a buoyancy element (2) on each inside and a cleaning element (4) on each outside.
- 15 11. Cleaning bodies according to claim 10, characterized in that said buoyancy element (2) is arranged at each center of said cleaning bodies (1a-1e') and is comprised of one or more pressure resistant hollow bodies, or hollow bodies made pressure resistant, e.g. of metal, or bodies having a low specific gravity, such as of metal foam.
- 20 12. Cleaning bodies according to claim 10 or claim 11, characterized in that the cleaning element (4) forms the contact surface of each of said cleaning bodies (1-1e') and consists of metal lamellae, knitted metal, metal mesh or metal foil or of a layer of temperature- and medium-resistant abrasive material attached either directly to said buoyancy element (2) or to an intermediate element.
- 25 13. Cleaning bodies according to any one of claims 10 to 12, characterized in that each cleaning element (4) is formed to be resilient.
14. Cleaning bodies according to any one of claims 10 to 13, characterized in that a resilient elasticity medium (3), such as metal foam, carries said cleaning element (4).

15. Cleaning bodies according to claim 6 or claim 7, characterized in that the cleaning bodies (1f-1h) each consist of at least a downstream – as seen in the flow direction of the liquid flow medium in said tubes (5) – buoyancy element (2) and a cleaning element (4) arranged at the upstream side thereof.
- 5 16. Cleaning bodies according to claim 15, characterized in that each buoyancy element (2) has a ball-shaped or spherical form and is made of metal sheeting or a high-temperature resistant plastics material.
- 10 17. Cleaning bodies according to claim 15 or 16, characterized in that each cleaning element (4) is leaf or disk shaped, has a circular form and is made of spring metal, and carries a crown of resilient lamellae (4a) acting as a contact surface and contacting the inner wall of the tube.
- 15 18. Cleaning bodies according to any one of claims 15 to 17, characterized in that each connection between said buoyancy body (2) and said cleaning element (4) allows limited relative axial movement and preferably limited relative radial movement of said buoyancy body (2) and said cleaning element (4).
19. Cleaning bodies according to one or more of claims 17 to 18, characterized in that said cleaning element (4) has clover-leaf-shaped lamellae (4a), which are separated from one another by a wide gap (4b) and have rounded corners (4c).
- 20 20. Cleaning bodies according to one or more of claims 15 to 19, characterized in that on either side of each cleaning element (4) a buoyancy element (2) is arranged.
- 25 21. Cleaning bodies according to any one of previous claims 6 to 10, characterized in that the material of said cleaning element (4), said resilient medium (3) and said buoyancy element (2) are resistant to temperatures (equal or greater than 120°C) as well as resistant to aggressive media, such as crude oil, and are preferably of metal.

22. Cleaning bodies according to one or more of claims 6, 7, 9 and 13, characterized in that said cleaning bodies (1) are formed as roller shaped metal brushes.